Spatial Awareness in Naval Aviation

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The Navy loses over $100 million per year due to aviation mishaps in which a pilot's loss of orientation is the major causative factor. Although most of us can rely on our inner ear and musculoskeletal sensations to keep us oriented in space these senses are not reliable during the accelerations and attitudes encountered in high-performance aircraft. Until now, pilots have had to ignore these false sensations and rely on their eyes to stay oriented by watching the horizon or instruments. In some cases, pilots have had insufficient time to process all of the visual information they have received, and accidents have resulted. Now, however, accurate information about spatial orientation can be made available to pilots through another sense, the sense of touch. The Naval Aerospace Medical Research Laboratory (NAMRL), Coastal Systems Station (CSS), and the U.S. Army Aeromedical Research Laboratory (USAARL) have collaborated to develop and test a Tactile Situational Awareness System (TSAS). This system provides continuous orientation information to a pilot through miniature "tactors," similar to those used in vibrating pagers, mounted in a body-hugging vest (see figure).

A flight demonstration was recently conducted at NAS Pensacola to show the effectiveness of the TSAS during helicopter hover operations. In a USAARL UH-60 helicopter, four test pilots flew the following hover maneuvers: in-ground-effect (IGE) hover, out-of-ground-effect (OGE) hover, as well as simulated shipboard operations in visual meteorological conditions (VMC) and instrument meteorological conditions (IMC). The test pilots successfully performed all maneuvers with highly restricted outside visual cues, relying on tactile cues for the necessary information. All pilots reported improved situational awareness and apparent reductions in workload when using the TSAS, particularly during the simulated IMC shipboard operations. The TSAS allows pilots to maintain control of aircraft during complex flight conditions because it allows the pilots' sensory input to be distributed over more senses. This distribution of sensory input allows pilots to devote more time to visual processing of information from other instruments and systems when flying in task-saturated conditions, thus enhancing pilots' mission effectiveness.

Previous flight tests using an earlier prototype of the TSAS were performed with a T-34C Turbo Mentor at NAS Patuxent River, Maryland. A Navy test pilot and flight surgeon flew the T-34 from the back seat with all instruments covered and a canvas hood in place, effectively removing all internal and external visual cues. In a series of flights, the pilot successfully completed all basic maneuvers, including aerobatic loops and rolls, using no instruments other than the TSAS. The orientation information provided by the TSAS was so intuitive, the pilot became proficient in its use after only 30 minutes of training.

Underwater applications the of TSAS have also been received enthusiastically. These will transfer to appropriate funding lines for further development.